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Effect of GA_3 and growing media on seed germination of papaya (*Carica papaya* L.) cv. Pusa Nanha

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Abstract
The present study was carried out to investigate "Effect of GA_3 and growing media on seed germination of papaya (*Carica papaya* L.) cv. Pusa Nanha". The study revealed that the treatments comprised combinations of soil, FYM, and vermicompost with varying levels of GA_3. The result indicated that GA_3 200 ppm is found to be the most effective for better germination of papaya seedlings. Among different growing media the treatment soil + FYM + vermicompost (1:1:1) was recorded higher values of germination parameters that are germination percentage, germination period, seed vigour (%), and germination index. The treatment combination of GA_3 200 ppm and growing media of soil: FYM: vermicompost (1:1:1) was found most suitable for growing of papaya nursery.

Keywords: Cucumber, boron, yield, quality, konkan

Introduction
Papaya is botanically known as *Carica papaya* L. and belongs to the family Caricaceae, is originated from tropical America (Hafmer, 1990) [10] and introduced in India during 16th century from Malacca (Kumar and Abraham, 1983) [12]. Papaya occupies 2.0 percent of total fruit crops area and 5.3 percent of total fruit production in India. It occupies a cultivated area of 126.0 thousand ha with an annual production of 5508.0 thousand MT with average productivity of 43.7 MT/ha (Anonymous, 2016) [2]. Papaya is generally propagated by seed (Cheema and Dhani, 1930) [8] and it is interested by the researchers due to the presence of gelatinous sarcotesta preventing germination and dormancy (Lange, 1961). Gibberellins act in the mobilization of seed reserves during the germination process. Therefore, GA_3 considered as a important germination promoters which increased the seed germination of papaya (Zanotti and Barros, 2014) [18]. Growing media plays an important role in seed germination and subsequent vegetative growth of seedlings (Srivastava *et al.*, 1998) [17]. Media not only acts as a growing place but also as a source of nutrient for plant growth. The soil is usually used as a basic medium because it is cheapest and easy to procure (Bhardwaj, 2013) [5]. Vermicompost provides sufficient levels of oxygen to roots, adequate storage of water and nutrient for the plants. FYM is having good water holding capacity as well as sufficient porosity.

Material and methods
The present investigation was carried out at Shade net house, Department of Fruit Science, K.N.K. College of Horticulture, Mandsaur (M.P.), Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during the year 2016-2017. The experiment was laid out in Factorial Complete Randomized Block Design. The experiment comprised of sixteen treatments with combination of GA_3 and growing media. Gibberellic acid (GA_3) presoaking for 12 hours with three concentrations i.e. GA_3 100 ppm, 150 ppm, 200 ppm and Control as water soaking of seeds and different growing media used in different ratio i.e. Soil as control, Soil: FYM (1:1), Soil: Vermicompost (1:1) and Soil: FYM: Vermicompost (1:1:1).

Results and Discussion

Effect of GA_3

The results (Table 1) revealed that the maximum (78.33 %) seed germination was observed in treatment GA_3 200 ppm as compare to untreated seeds (55.00 %). The shortest germination period (10.75 days) was observed in treatment GA_3 200 ppm where as longest germination period (15.58 days) was found in untreated seeds. Similarly, the highest seed vigour (84.17 %) was observed in treatment GA_3 200 ppm as compare to untreated seeds (67.17 %). The promising effect of GA_3 as pre-sowing treatment to the seeds replaced the dormancy mechanism of the seeds resulting in early germination (Khan, 1981) [11]. Gibberellic acid acts on the embryo and causes synthesis of hydrolyzing enzymes particularly α- amylase and protease and this hydrolyzed food is utilized for growth of embryo and thereby germination enhanced (Paleg, 1965) [15] and reduced number of days until germination (Nagano *et al*., 2010) [13]. Similar results were reported by Dhankhar *et al*. (1997) [9] in aonla; Bharche *et al*. (2010) and Babu *et al.* (2010) [4, 3] in papaya. The result of germination index was observed non-significant.

Growing media

Among different media significantly treatment M_3 (Soil + FYM + vermicompost (1:1:1)) had maximum germination percentage (72.08 %) followed by M_2 (Soil + vermicompost (1:1)) (69.17 %) and minimum (57.92 %) in M_0 (Soil). The shortest germination period (11.50 days) was observed in treatment M_3 (Soil + Vermicompost + FYM (1:1:1)) and longest germination period (13.75 days) found in M_0 (control). Similarly, highest seed vigour (78.50 %) was recorded in treatment M_3 (Soil + Vermicompost + FYM (1:1:1)) and lowest (68.00 %) in M_0 (control). The promising effect of M_3 on seed germination might be due to its appropriate cation exchange capacity for retention of nutrients and having the properties of good water holding capacity as well as sufficient porous, so that permitting adequate moisture and exchange of gasses between the germination growth media and the embryo, that is essential for rapid and uniform germination of seeds Narayan *et al*. (2008) and Bihari *et al*. (2009) [14, 6] reported in Aonla, Parasana *et al*. (2013) [16] in mango. The effect of media on germination index was recorded non-significant.

Interaction effect

Interaction effect of G_3M_3 (Soil + Vermicompost + FYM (1:1:1) + GA_3 – 200 ppm) recorded highest seed vigour (86.67 %) followed by G_3M_2 (85.00 %), G_3M_1 (83.33 %) and G_3M_0 (81.67 %). Lowest seed vigour (53.33 %) was recorded in G_0M_0. The promising effect of GA_3 on seed germination might be due to its participation in the activity of alpha-amylase, which catalyzes the starch conversion in to simple carbohydrates and chemical energy is liberated which is used in the activation of embryo resulting effective germination (Anjanawe *et al.*, 2013) [1]. The growing media also increase beneficial effect of all components in improving physical, biological and chemical properties of media as soil provides natural support, FYM provides proper aeration, vermicompost gives warm condition and high water holding capacity while FYM as organic manure provided better nutrition to the germinating of seedlings (Hartmann and Kester, 1997). Further the vermicompost also provides a uniform physical structure which ensures close contact between seed and media, increases steady moisture supply, facilitates root respiration and encourages overall plant growth. It exhibits a beneficial effect on soil health and all these attributes might enhance the seed germination and seedling growth of moringa at the initial stage (Chatterjee and Choudhari, 2007) [7]. However, the other observation parameters like germination percentage, germination period and germination index affected non-significantly by interaction of GA_3 and growing media.

Table 1.

Treatment	Treatment details	Germination percentage (%)	Germination period(days)	Seed vigour (%)	Germination index
G0	Untreated seed	55.00 (47.91)	15.58	67.17 (55.25)	1.17
G1	GA_3- 100ppm	57.50 (49.33)	12.67	67.83 (55.49)	1.19
G2	GA_3- 150ppm	71.25 (57.64)	11.75	73.67 (59.15)	1.22
G3	GA_3- 200ppm	78.33 (63.02)	10.75	84.17 (66.70)	1.34
SE(m)		1.82	0.30	1.26	0.07
C.D. at 5%		5.26	0.89	3.64	NS
M0	Soil	57.92 (49.64)	13.75	68.00 (55.85)	1.14
M1	Soil + FYM (1:1)	62.92 (52.59)	13.00	71.83 (58.17)	1.18
M2	Soil + Vermicompost (1:1)	69.17 (56.89)	12.50	74.50 (59.95)	1.29
M3	Soil + Vermicompost + FYM (1:1:1)	72.08 (58.77)	11.50	78.50 (62.63)	1.32
SE(m)		1.82	0.30	1.26	0.07
C.D. at 5%		5.26	0.89	3.64	NS
G0M0	Untreated seeds + Soil	43.33 (41.14)	17.00	53.33 (46.90)	1.05
G0M1	Untreated seeds + Soil + FYM (1:1)	56.67 (48.83)	15.67	64.67 (53.53)	1.09
G0M2	Untreated seeds + Soil + Vermicompost (1:1)	56.67 (48.91)	15.33	72.33 (58.29)	1.26
G0M3	Untreated seeds + Soil + Vermicompost +FYM (1:1:1)	63.33 (52.75)	14.33	78.33 (62.26)	1.27
G1M0	GA_3-100 ppm + Soil	53.33 (46.90)	14.00	64.67 (53.53)	1.06
G1M1	GA_3-100 ppm + Soil + FYM (1:1)	56.67 (48.83)	13.00	67.00 (54.92)	1.17
G1M2	GA_3-100 ppm + Soil + Vermicompost (1:1)	60.00 (50.83)	12.67	67.33 (55.21)	1.18
G1M3	GA_3-100 ppm + Soil + Vermicompost +FYM (1:1:1)	60.00 (50.75)	11.00	72.33 (58.29)	1.34
G2M0	GA_3-150 ppm + Soil	66.67 (54.76)	12.67	72.33 (58.29)	1.16

G2M1	GA_3-150 ppm + Soil + FYM (1:1)	70.00 (56.77)	12.33	72.33 (58.29)	1.17
G2M2	GA_3-150 ppm + Soil + Vermicompost (1:1)	73.33 (58.98)	11.33	73.33 (58.91)	1.33
G2M3	GA_3-150 ppm + Soil + Vermicompost +FYM (1:1:1)	75.00 (60.05)	10.67	76.67 (61.12)	1.22
G3M0	GA_3-200 ppm + Soil	68.33 (55.75)	11.33	81.67 (64.67)	1.29
G3M1	GA_3-200 ppm + Soil + FYM (1:1)	68.33 (55.95)	11.00	83.33 (65.93)	1.28
G3M2	GA_3-200 ppm + Soil + Vermicompost (1:1)	86.67 (68.83)	10.67	85.00 (67.38)	1.37
G3M3	GA_3-200 ppm + Soil + Vermicompost +FYM (1:1:1)	90.00 (71.54)	10.00	86.67 (68.83)	1.43
SE(m)		3.65	0.61	2.53	0.15
C.D. at 5%		NS	NS	7.29	NS

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